wholly of fruit wall minus the outer husk. The most distinctive features in the microscopical appearance are the small brown plates showing a honeycomb structure and small brown plates furnished with stiff needle-shaped hairs, probably portions of outer epidermis and underlying tissue. According to Eitner (*loc. cit.*), guara contains a mixture of pyrogallol- and catechol-tannins, but practically all the reactions of guara tannin were found to agree with a pyrogallol-tannin closely resembling the tannins of sumach or myrobalans. Thus a dilute aqueous infusion of guara gives a violet-blue coloration with iron alum, no precipitate with bromine water, no phloroglucinol reaction with a deal shaving, a yellow precipitate turning green with lime water, a slight precipitate with formaldehyde and hydrochloric acid, a yellow coloration with sodium sulphite, an intense red or brownish-red coloration with an ammoniacal solution of potassium ferricyanide in very dilute solution, a pink to purple coloration with Bennett's iodine test, and a deep orange-brown colour with nitrous acid. With concentrated sulphuric acid, however, a crimson-pink coloration changing to pink on dilution is obtained—a reaction given by most catechol-tannins.

A number of analyses of various samples of guara made during the past two years show that material of a remarkably constant quality is being supplied. The following are typical analyses, carried out according to the official method of the International Association of Leather Trades Chemists :—

	Tans.	Non-tans.	Insoluble.	Moisture.
	%	%	%	%
1.	43·5	23·8	22·0	10·7
2.	46·2	25·8	19·0	9·0
3.	48·4	23·2	17·7	10·7
4.	44·8	23·1	21·7	10·4

Mr. H. Lang, of the Gryfe Tannery, Ltd., kindly carried out for me a number of tanning experiments with guara and also made trials of this material on the large scale in conjunction with other tanning materials. According to these experiments, skins tanned entirely with guara gave a soft, well-filled leather, resembling a gambier tannage rather than a sumach or myrobalan tannage such as the presence of pyrogallol-tannins might lead one to expect. The well-nourished appearance of guara-tanned leather may therefore be largely due to the nature of the non-tannins present.

Guara is quite free from the liability to give excessive fermentation such as is characteristic of divi. However, its fine state of subdivision prevents guara from being readily leached, although the tanning matters are very readily soluble. Guara has been found excellent for developing acidity in the tan-liquors, and when used with untreated quebracho extract has a very favourable influence on the colour of the leather. It has been found particularly useful mixed with quebracho extract in the paddle, as it does not draw the grain but gives a soft and mellow tannage. The most characteristic features of guara are its acid-forming properties and the light colour and mellowness of the tannage.

Guara extract. Only one sample of guara extract (solid) has been examined, as this material is no longer imported.

The analysis gave tans, 41·7% ; non-tans, 30·0% ; insoluble, 11·0% ; moisture, 17·3%, agreeing closely with the analysis given by Eitner. Guara extract gives a very dark coloured infusion and besides being actually weaker in tannin, is inferior in all respects to the natural product. The large amount of insoluble matter makes its filtration during analysis very difficult. It is reported by Eitner to make a dark-coloured and unsatisfactory leather, and as it has not been favourably received by British tanners it is no longer imported.

NOTE ON THE ANALYSIS OF TANNING MATERIALS.

BY THOS. CALLAN, M.SC., PH.D.

Whilst the experiments on guara described in the previous paper were in progress, there appeared a paper by H. G. Bennett (this J., 1914, 1182—1184) in which a modified method of tannin analysis was proposed.

Briefly stated, Bennett proposes to modify the present official method of the International Association of Leather Trades Chemists by (1) exactly neutralising the hide powder before the preliminary chroming, (2) using less hide powder, (3) diluting the solution to be detannised with an equal volume of water, (4) using a more basic chromium salt for chroming. The object of these modifications is to obtain lower tannin results and higher non-tannins, this being a step towards greater accuracy, as the chief objection to the present method is that the hide powder absorbs small quantities of non-tannins as well as tannins. To test this new method analyses were made of guara using (1) the present official method with American hide-powder of standard quality, (2) Bennett's method using American standard hide-powder, (3) Bennett's method using finely ground hide-powder obtained from the Deutsche Versuchsanstalt für Lederindustrie, Freiberg. Using the same tannin solution, the amount of non-tannins obtained by these three methods were, to give only one example, 23·1%, 28·1%, and 25·4% respectively. Repeat experiments gave similar results.

In each case 50 c.c. of the detannised filtrate was tested by the official test for tannin (the addition, drop by drop of a 1% gelatin-10% salt solution) when no turbidity or opalescence was obtained, indicating apparent complete detannisation. This would indicate that the most accurate result was No. 2 showing the least absorption of non-tannins. The correctness of this reasoning, however, depends entirely on the trustworthiness of the official gelatin-salt test. The non-tannin filtrates were therefore re-tested by the tannin test devised by Stiasny, which consists of adding 1 c.c. of a saturated salt solution, then 2 drops of 1% metaphosphoric acid solution, and finally 2 drops of 5% gelatin-5% salt solution to 3 c.c. of the solution to be tested. With this more sensitive test No. 1 and No. 3 showed no tannin, whilst No. 2 showed a distinct trace. The dried non-tannin residues after weighing were therefore dissolved in 15 c.c. of warm distilled water, filtered and 3 c.c. tested by Stiasny's test. No. 1 gave no reaction, No. 2 gave a heavy precipitate, whilst No. 3 gave a distinct opalescence, indicating a slight trace of tannin. From these experiments with guara, which were repeated several times with similar results, the only method showing perfect detannisation is the present official process, although the amount of tannin remaining unabsorbed in Bennett's method when the finely ground Freiberg powder is used, is very small. Although the present official method undoubtedly detannises very completely, this does not mean that it is the more accurate, as these experiments do not show how much non-tannin is also absorbed A number of experiments were then made to determine the approximate degreee of accuracy of the present official tannin test. With a solution of guara and also of chestnut extract it was found that 50 c.c. containing 10 mgrms. of tannin gave a distinct reaction, whilst 6·5 mgrms. in 50 c.c. could not be detected, although Stiasny's test readily showed as little as 3 mgrms. in 50 c.c. when only 3 c.c. of solution was taken for the test. With quebracho extract the official test is more delicate, indicating distinctly 5 mgrms. but not 2·5 mgrms. of tannin in 50 c.c. It follows, therefore, that a solution apparently completely detannised when tested by the official method may still contain, with some tanning materials, up to 6·5 mgrms. of tannin in 50 c.c. This would correspond in the case of a tanning material containing about 50% tannin to nearly 2% tannin, whilst with Bennett's method, owing to increased dilution, it corresponds to about double this amount. Before conclusions as to the relative efficiency of different methods of detannising tannin solutions can be drawn, it is therefore necessary that a more stringent test than the present official tannin test be used. A sufficiently stringent test would be to concentrate 6 c.c. of the presumably detannised solution (or 12 c.c. if Bennett's method or other method involving solutions more dilute than the present limits be used) to 3 c.c. and apply Stiasny's test.

In the course of a number of analyses of various tanning materials it was found, as in the case of guara, that the non-tannin filtrates obtained in Bennett's method, using standard American hide powder, showed in many, though not all, cases distinct traces of tannin, even after shaking 20 minutes with hide powder, when tested by the more sensitive method after concentration, although no tannin was shown by the official test. It would appear therefore that the alteration in the various factors in this method, designed to reduce absorption of non-tannins, has been carried too far, and although in all probability the gain in accuracy owing to reduced absorption of non-tans is more than the error introduced by the non-absorption of traces of tannin, the presence of this latter error will probably prove a strong objection to the method as it now stands.

In conclusion it may be noted that although Stiasny's test will give a positive reaction with gallic acid in sufficiently concentrated solution, it will not show 150 mgrms. of gallic acid in 50 c.c., which is about the maximum amount of gallic acid likely to be present in a detannised solution even after concentrating to half its volume.

Sydney Section.

THERMO-REGULATOR FOR THERMOSTATS.

BY C. W. R. POWELL.

Errata.

In the report of the author's reply to questions, on p. 900 of the Sept. 30th, 1914, issue of this Journal, for "within half a degree" read within "one twentieth of a degree," and for "3 litres" read "3 gallons."

Obituary.

HUGO MÜLLER.

Dr. Hugo Müller died suddenly, in his eighty-second year, at Camberley, Surrey, on May 23rd. He studied chemistry under Erdmann in Leipzig and Wöhler in Göttingen, where in 1853 he took the Ph.D. degree. He then went to Munich to act as assistant to Liebig, but soon came to England, on Hofmann's invitation, to assist Warren de la Rue in the investigation of Burmese naphtha: through the advice which he was able to give when consulted by Thos. De la Rue and Co. (in whose factory they had their laboratory) it became so obvious, after a time, that the services of a chemist would be of value, that he was induced to enter the firm, though originally he had intended to adopt a scientific career; he ultimately became a partner and a director when the business was made into a limited company. A man of wide knowledge, possessed of great technical skill and manipulative power, he contributed very largely to the development of the business, especially in the Stamp and Bank Note Departments in which his artistic as well as his scientific gifts were of peculiar value; he was one of the first to develop electrotyping and much improved lithographic and colour printing in this connexion; he was also a great authority on paper and the author of an important monograph on cellulose, the first to deal with the subject in any thorough manner. He retired in 1902 and then took up work in the Davy-Faraday Laboratory founded by Dr. Mond in connexion with the Royal Institution. During the past twelve years, he has been a constant attendant there, working long hours daily—not the short time which Professor Perkin recently deprecated, in his Presidential address, as customary among young students in the Oxford laboratory. Two investigations of superlative interest were carried out by him during this period—one relating to a substance (*Cocosite*) which he first met with in palm leaves but subsequently identified with the scyllitol separated from the dog-fish, an isomeride of inositol; the other to the peculiar bloom on the leaf and flower-stalk of many species of primula, which he identified with Flavone; this was previously unknown as a natural product, and the discovery is of special interest, as Flavone is the parent of a great group of yellow colouring matters present in plants. In execution, these two inquiries are models of method and remarkable as examples of the great technical skill of the school to which Dr. Müller belonged, which now unfortunately has so few followers.

Dr. Müller, at first an ardent mineralogist, through his love of Nature, gradually passed over to botany and to horticulture; during the past 30 years, he has been noted as a gardener, particularly for his knowledge of the habits of plants. He was a man who was greatly beloved by his circle of friends. He was elected a Fellow of the Royal Society in 1866. He entered the Chemical Society in 1859 and served it as Foreign Secretary from 1869 to 1885, when he became President. He was an original member of this Society.